[0176] Using embodiments of the invention, one could find a specific segment of a nucleic acid of a gene, i.e., find a site with a particular order of bases in the examined gene. This detection could be performed by using a diagnostic polynucleotide made up of short synthetically assembled single-chained complementary polynucleotides—a chain of bases organized in a mirror order to which the specific segment of the nucleic acid would attach (hybridize) via A-T or G-C base pairing interactions.

[0177] The practice of the embodiments-of the invention may employ, unless otherwise indicated, conventional techniques of organic chemistry, polymer technology, molecular biology (including recombinant techniques), cell biology, biochemistry, and immunology, which are within the skill of the art. Such conventional techniques include polymer array synthesis, hybridization, ligation, detection of hybridization using a label. Specific illustrations of suitable techniques can be had by reference to the examples herein below. However, other equivalent conventional procedures can, of course, also be used.

[0178] The devices of the embodiments of the invention may be formed by any suitable means of manufacture, including semiconductor manufacturing methods, microforming processes, molding methods, material deposition methods, etc., or any suitable combination of such methods. In certain embodiments one or more of the microcoils, and circuitries may be formed via semiconductor manufacturing methods on a semiconductor substrate. Thin film coatings may be selectively deposited on portions of the substrate surface. Examples of suitable deposition techniques include vacuum sputtering, electron beam deposition, solution deposition, and chemical vapor deposition. The coatings may perform a variety of functions. For example, the coatings may be used to increase the hydrophilicity of a surface or to improve high temperature properties. Conductive coatings may be used to form the microcoils. Coatings may be used to provide a physical barrier on the surface, e.g. to retain fluid at specific sites on the surface.

[0179] In one embodiment of the invention, the substrate is made through combining two or more smaller substrates or solid support. Specifically, the fabricating of the fluidic zones, or the fabricating of the microcoils may involve combining two or more smaller substrates to form the substrate.

[0180] The substrate used in the embodiments of the invention may comprise various materials including, but not limited to silicon, glass, metal, and polymeric material. According to the embodiments, the substrate comprises an integrated circuit, a microarray, a macroarray, fluidic zones, a detection element, a vibration element, or a combination thereof.

[0181] In on embodiment of the invention, the sample zone for holding a sample comprises a reservoir, a channel, an opening, a surface, or a combination thereof. According to another embodiment, the microcoil comprises of copper, aluminum, gold, silver, or a mixture thereof. The microcoil is placed near or adjacent to the fluidic zones.

[0182] As disclosed herein, silicon is a suitable material for attaching other materials, such as metal or magnetic materials and forming structures, such as openings and channels coupled with microelectronics or other microelectromechanical systems (MEMS). It also has good stiffness, allowing the formation of fairly rigid microstructures, which can be useful for dimensional stability. In a specific embodiment of the invention, the substrate comprises an integrated circuitry component selected from an integrated circuit (IC), a packaged integrated circuit, and an integrated circuit die. For example, the substrate may be a packaged integrated circuit that comprises a microprocessor, a network processor, or other processing device.

[0183] In another embodiment, the method further comprises forming circuitry on or within the detection unit that is capable of amplifying or processing the signals detected by the detection element. The substrate for the detection element may be constructed using, for example, a Controlled Collapse Chip Connection (or "C4") assembly technique, wherein a plurality of leads, or bond pads are internally electrically connected by an array of connection elements (e.g., solder bumps, columns).

[0184] According to the embodiments of the invention, microcoils can be fabricated on or within the substrate using a number of techniques, including etching, bonding, annealing, adhering/seeding, lithography, molding, and printing. Physical vapor deposition (PVD) and chemical vapor deposition (CVD) can also be used. In one embodiment, microcoils are fabricated on an oxidized silicon substrate by electroplating metals inside a deep photoresist mold and then passivated using an epoxy based resist.

[0185] The substrate of the embodiments of the present invention is suitable for forming openings, voids, surfaces, or microchannels thereon for holding fluid and fluidic communications. The sample zone may be open or closed along. Various methods may be used to form the sample zone on the substrate. For example, a reservoir or an open microchannel can be fabricated on a silicon substrate by etching methods known to those skilled in the art. Closed channels can be formed by sealing the open channels at top using methods such as anodic bonding of glass plates onto the open channels on the silicon substrate.

[0186] According to one embodiment of the invention, to fabricate a channel on a silicon substrate, a photoresist (positive or negative) is spun onto the silicon substrate. The photoresist is exposed to UV light through a high-resolution mask with the desired device patterns. After washing off the excessive unpolymerized photoresist, the silicon substrate is placed in a wet chemical etching bath that anisotropically etches the silicon in locations not protected by the photoresist. The result is a silicon substrate in which channels are etched. If desired, a glass cover slip is used to fully enclose the channels. Also, holes are drilled in the glass to allow fluidic access. For straighter edges and a deeper etch depth, deep reactive ion etching (DRIE) can be used as an alternative to wet chemical etching.

[0187] In another embodiment of the invention, channels may be formed on a silicon substrate using the following method. A seed layer of a metal, such as copper, is deposited over a surface of the substrate. Any suitable blanket deposition process may be used to deposit the seed layer of metal, such as physical vapor deposition (PVD), chemical vapor deposition (CVD), or other methods known to those skilled in the art. A layer of a sacrificial material, such as a dielectric material or a photoresist material, is then deposited over the seed layer. By removing the sacrificial material, for example using chemical etch process or thermal decomposition process, a number of trenches in the sacrificial layer are formed, and the seed layer is exposed in each of the trenches. Another layer of the metal, such as copper, is deposited over the exposed seed layer in the trenches. The metal layer extends over portions of the upper surface of the sacrificial layer; but gaps remain between the metal material layers extending